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PATENT APPLICATION

SYSTEMS AND METHODS FOR A SAFETY CIRCUIT FOR AN ELECTRIC MOTOR

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SYSTEMS AND METHODS FOR A SAFETY CIRCUIT FOR AN ELECTRIC MOTOR

CROSS-REFERENCES TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Application No. 60198207, (Attorney Docket No. 1601001000US) filed April 19, 2000 which is herein incorporated by reference for all purposes.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is directed to a safety circuit for use in an electric motor, and more particularly, to a safety circuit for an electric motor for use with pumps that prevents operation of the electric motor if the motor's connection to ground is lost.

2. Description of the Prior Art

Currently, pumps are used for many applications. Many of these pumps are powered by electric motors. Since pumps are generally used for pumping liquids and fluids, it is important that the electric motor be coupled to ground in order to help minimize injuries due to electric shock.

Safety laboratories that test and certify electrical products for safety currently look only for the integrity of the electrical insulation in machines. Thus, these machines may operate even if they are not grounded. For obvious reasons, this is unsafe.

Generally, it has been observed that if one deliberately disconnects or inadvertently disconnects the (safety) ground on most operating electrical devices on the market today, that device will continue to operate. For obvious reasons, this is not a desirable situation.

BRIEF SUMMARY OF THE INVENTION

The present invention provides a safety circuit for an electric motor that includes at least one power input, at least one motor winding and an input ground. The safety circuit includes a relay coupled to the power input and the input ground. At least one transistor switch is coupled to the relay, the power input and the motor winding. If the relay is properly coupled to ground, then the transistor switch will be turned on and current will be allowed to flow between the power input and the motor winding, thus allowing the electric motor to operate. If the relay is not coupled to the input ground, then the transistor switch will be turned off and power will not be allowed to flow between the power input and the motor winding.

In accordance with one aspect of the present invention, the relay comprises an inductor that is inductively coupled to the transistor switch. In accordance with another aspect of the present invention, the relay comprises a resistor that is coupled to the transistor switch.

The present invention also provides a method of operating an electric motor.

Other features and advantages of the present invention will be understood upon reading and understanding the detailed description of the preferred exemplary embodiments found herein below, in conjunction with reference to the drawings, in which like numerals represent like elements.

BRIEF DESCRIPTION OF THE DRAWING

Figure 1 is a schematic illustration of a safety circuit for an electric motor in accordance with the present invention.

DESCRIPTION OF PREFERRED EXEMPLARY EMBODIMENTS

With reference to Figure 1, a schematic wiring diagram for a control box of an electric motor is illustrated. The electric motor is especially suitable for a pump. However, those skilled in the art will understand that the electric motor and the circuit illustrated in Figure 1 have many other uses and may be modified according to needs.

L1 and L2 are inputs for input power to the electric motor. Thus, in the present example, the electric motor is a 220 volt motor and L1 and L2 represent 110 volt inputs.

Inputs T2 and T7 are inputs to the motor's winding. Inputs T4 and T5 are preferably coupled to a thermal switch or temperature sensor. As can be seen in Figure 1, input T3 preferably is coupled to input ground and input T4. T6 is preferably coupled to a starter and starter switch circuit 10.

A safety circuit 20 is also provided. Preferably, the safety circuit includes a relay portion 21 coupled to the input power L1 and L2 and one of the thermal switch terminals (thus, being coupled to ground). Additionally, the safety circuit also preferably includes two transistor switches 22, 23, one of which is coupled to input power L1, while the other is coupled to input power L2.

In the example illustrated in Figure 1, the relay portion of the safety circuit includes an inductor K1. The inductor is inductively coupled to both of the transistor switches. Thus, when input power is provided in L1, a current flows through the relay branch thus creating current through the inductor. This current through the inductor pulls the gates

of the transistor switches high, thus short circuiting the transistors and allowing current to flow from the input power leads to the motor winding leads.

If the ground connection is lost in the relay portion, the current would stop flowing through the relay branch, thus de-energizing the relay inductor coil. Accordingly, the transistor switches would be "closed" since the gates would now be low and current would fail to flow through the transistor switches to the motor winding inputs. Accordingly, the electric motor would not operate.

In an alternative embodiment, the inductor is replaced with a resistor that is directly coupled to the gates of the transistor switches. When current flows through the relay portion, the resistor "opens" the transistor switches by pulling the gates high due to the potential at the resistor. Likewise, if current is not flowing through the resistor, for example, due to the relay portion's connection with ground being lost, then the transistors close.

As can also be seen in Figure 1, the circuit preferably includes an electronic starter switch circuit 10 coupled to starter input T6 and the transistor switches for manually controlling turning on and off the electric motor. Electronic switch circuit 10 is merely an example of a starter circuit known in the industry.

Although the invention has been described with reference to specific exemplary embodiments, it will be appreciated that it is intended to cover all modifications and equivalents within the scope of the appended claims.